SMART ONLINE ELECTRICAL BILLING MANAGEMENT SYSTEM (SOEBIMS) USING GSM

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ABSTRACT

Nowadays the billing system integrated with smart meter is used by staffs, residents and those who use electricity to retrieve the price rate and meter value of power consumption. There are several billing system integrated with smart meter invented in Italy, Sweden, UK, USA and so on. However, the current metering system in Malaysia is not capable to measure variable time price and it is gradually replaced by digital or smart meters. The purpose of this study is to develop a prototype of Smart Online Electrical Billing Management System (SOEBIMS) using GSM. SOEBIMS is an online web application as it can reduce human errors and save time to key in the data from keyboard. SOEBIMS helps to retrieve the real time meter value via GSM and send it to customer's mobile phone through GSM. The staffs allow modifying the variable package price in specific duration. The administrator can analyze the customer's power consumption data and generate the report from the data online. The prototype is developed using waterfall model as the prototype can be implement and develop by followed the sequential phases. The prototype will be able to introduce the billing system to the customers, get the power consumption data from smart meter, keep the data in centralized database and generate the report. It will help the user to access the data and report easily through online.

ABSTRAK

Pada masa kini, sistem bil bersepadu meter pintar digunakan oleh kakitangan, penduduk dan orang-orang yang menggunakan elektrik untuk mengambil kadar harga dan nilai meter penggunaan kuasa. Terdapat beberapa bil sistem yang disepadukan dengan meter pintar yang dicipta di Itali, Sweden, United Kingdom, Amerika Syarikat dan sebagainya. Walau bagaimanapun, sistem pemeteran semasa di Malaysia tidak mampu untuk mengukur harga masa berubah dan ia beransur-ansur digantikan dengan meter digital atau pintar. Tujuan kajian ini adalah untuk membangunkan satu prototaip *Smart Online Electrical Billing Management System* (SOEBIMS) *using GSM*. SOEBIMS adalah aplikasi web kerana ia boleh mengurangkan kesilapan manusia dan menjimatkan masa untuk memasukkan data dari papan kekunci. SOEBIMS membantu untuk mendapatkan meter masa nilai sebenar melalui GSM dan hantar ke telefon bimbit pelanggan melalui GSM. Kakitangan membenarkan mengubahsuai pakej harga berubah-ubah dalam tempoh tertentu. Pentadbir boleh menganalisis data penggunaan kuasa pelanggan dan menjana laporan daripada talian data. Prototaip yang dibangunkan dengan menggunakan model air terjun sebagai prototaip boleh melaksanakan dan membangunkan oleh diikuti fasa berurutan. Prototaip akan dapat memperkenalkan sistem bil kepada pelanggan, mendapatkan data penggunaan kuasa dari meter pintar, menyimpan data dalam pangkalan data berpusat dan menjana laporan. Ia akan membantu pengguna untuk mengakses data dan melaporkan dengan mudah secara online.

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LIST OF ABBREVIATIONS

3G - 3rd Generation

AC – Alternating Current

AMI - Advanced Metering Infrastructure

AMR – Automatic Meter Reading

ASI – Associated System Incorporation

CDMA – Code Division Multiple Access

CD-ROM - Compact Disc-Read Only Memory

CEO – Chief Executive Officer

CIS - Computer Information Systems

CRM - Customer Relationship Management

DFD – Data Flow Diagram

ENEL - **E**nte **N**azionale per l'energia **El**ettrica

ERD - Entity Relationship Diagram

EU - European Union

GB – GigaByte

GPRS - General Packet Radio Service

GSM – Global System for Mobile Communications

IC – Identity Card

kWh – kiloWatt hour

LAN – Local Area Network

LED – Light Emitting Diode

MAN – Metropolitan Area Network

MB – MegaByte

Mhz – Megahertz

PLC - Programmable Logic Controller

RAM - Random Access Memory

SABS - South African Bureau of Standards

SDLC – Software Development Life Cycle

SDM – Systems Development Method

SIM – Subscriber Indentity Module

SMS - Short Message Service

SQL - Structured Query Language

SSGC - Sichuan South Gas Compressor Company

ST - Singapore Technologies

TNB – Tenaga Nasional Berhad

TV – Television

US – United States

USA - United States of America

USB - Universal Serial Bus

WAN – Wide Area Network

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

The overview of this research will be briefly discussed through this chapter. It contains five parts; which are introduction, problem statement, objectives, scopes, and thesis organization.

1.1 Introduction

Since 19th century the monitoring of electricity is performed using electromechanical meters or electrical meters. Even though these meter are a master art of engineering designed a hundred of years ago measuring in kilowatt hour (kWh) but still they are not capable to measure new rates structures i.e. variable time pricing and are unable to provide awareness to users about their power consumption pattern. In traditional monitoring, human labour i.e. a lineman plays a significant role in the collecting and managing field data. However, due to the size increase of consumption areas, this conventional practice is considered time consuming and labour intensive. Around hundreds plus of the linemen and other supporting staff are required for this manual data collection process (Anderson, 1998). This process always has chances of human error. The current metering system in Malaysia is not capable to measure variable time price and it is gradually replaced by digital or smart meters.

Power management system provides high quality alternating current (AC) power to

control the flow of power (Dudas, 2002). It allows monitoring and delivering electrical power in more efficiently and accurately (Freescale Semiconductor, Inc., 2011).Examples of electrical appliances are computers, mobile phone, printers etc. When the electrical appliances are inactive, the power will manage the system and able to turn off to a low-power state automatically (Domingo & Landmann, 2010).

The trend change for smart metering also affected the Asian region. Sichuan South Gas Compressor Company (SSGC) who is responsible for more than 80% of power networks in China announced huge investment in term of smart grid. Smart meters will be an integral part of these change programs. Advanced Metering Infrastructure (AMI) which utilizes two-way communications to enable real-time monitoring and control of energy use in residential, commercial, and industrial buildings will be an important tool for utilities to accomplish their smart grid objectives. According to a new forecast from Pike research group, China will represent more than three-quarters of the installed base of smart meters in Asia Pacific, and the government has declared plans to continue a large-scale meter deployment through at least 2020 (Ovel, 2011).

Singapore is also competing in this technology, the authorities signed a deal to shift to advance metering. ST Engineering's electronics arm, ST Electronics, on 13th Sep, 2010 announced that its subsidiary, Telematics Wireless Ltd has been awarded a contract worth US$21.5m (about S$29m) by Arad Technologies Ltd (Arad) to supply Automatic Meter Reading (AMR) radio transceivers for Arad's DIALOG 3G AMR solutions. The supply cooperation agreement between Arad and Telematics Wireless takes effect immediately and extends to 2015 (Business News, 2010).

Tenaga Nasional Berhad (TNB) is the largest electricity utility company in Malaysia that providing excellent services to the customers. There are approximated RM71.4 billion worth in assets and approximately 28,000 staffs serve seven millions of customers. In order to raise the economic growth and develop the social in the country, TNB continues to lead the effort (TNB, 2011). It shows that Malaysia being a rapidly growing developing country towards adaptation of technologies. To adopt and change with changing technologies is a healthy approach to keep ourselves up dated. But if a careful analysis is not taken into consideration this change may result into drawbacks rather than making some solid contribution and achievement. Malaysia in 2007 signed a deal with International metering supplier company for installation of a number of smart meters that was expected to be a move towards technology in metering infra-structure (AMI, 2007 and NTDW, 2007).

Smart Online Electrical Billing Management System (SOEBIMS) using GSM is an online system that keeps track of customer's power consumption by using GSM. GSM is one of the digital communication technologies that allow sending and receiving voice and data services at anywhere and anytime (GSMA, 2011). By using GSM, the system can receive the customer's power consumption information hourly. Besides that, it saves the electricity, energy and battery automatically when the GSM is not activated. By using this system, TNB can save costs on hiring staffs and may reduce the use of paper to print the electrical bill. The system can read and retrieve the value of meter then send it to TNB database via GSM. The centralized database of the system allows the TNB staffs to manage the billing statement easily. The report generation of power consumption by hourly allows customers to be aware of the power usage and it can help the customers to reduce cost by planning the usage of the electrical appliances. The system uses the variable package price rate to do calculation, so it allows saving time for entering the meter value and help to reduce human error made as the system is done automatically and more accuracy. This system also allows the TNB staffs to monitor and modify the variable package price rate based on the peak hour without hiring programmers for modification of the system.

1.2 Problem Statement

Nowadays, the monitoring of electricity is still required the human to record the meter value from the house customers have to receive the electricity bill then able to make payment without knowing the accuracy of power used by the house owner. The value of meter may not be very accurate as the meter value is entered by human and sometimes human may make mistakes when entering the meter value. This leads to the serious problem when the workers have to go to the house again and re-enter the meter value in order to correct it. Furthermore, it is difficult to keep track the customer's value of meter and calculates the usage of power for large resident area. Besides, the customer cannot keep track of the usage of the power consumption hourly and cannot plan on the power consumption. It is also difficult to manage the price of customer's power used in meter without centralized server.

1.3 Objectives

This research consists of several objectives as stated below:

i. To develop an online system to manage electrical billing for the administrator and customer.
ii. To collect the power consumption information and integrate with centralized database system via GSM device.
iii. To calculate the electrical bill and generate a report on the power consumption information through online.

1.4 Scopes

The scopes of this project are:

i. System Platform and Architecture
   The system collects the power consumption information and send to the centralized server every hour through GSM.
ii. Data
   The system can generate the reports based on the power consumption information received from GSM for customer respectively.
iii. System Functionality
   The system allows the customers to access and view the value and the accumulate cost of power used through online with centralized database.
iv. System User
   The target users of this system are the customers and TNB person in charge.

1.5 Thesis Organization

There are four chapters in this thesis. Chapter 1 will introduces the system by showing the basic concept, problem statements, objectives, scopes, and thesis organization. Chapter 2 describes the manual and existing systems. Besides, it also depicts the technique, method, equipment, and technology that had been used in those existing systems and also those will be used in this research. Chapter 3 elaborates about the overall workflow in the development of the project, which includes the method, technique or approach that has been used while designing and implementing the project. Chapter 4 summarizes the project.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to explain the research on Smart Online Electrical Billing Management System (SOEBIMS) using GSM. This chapter reviews the manual system, current or existing systems, technologies, techniques and methods used.

2.1 Manual System

In traditional monitoring, human labour which is a lineman plays a significant role in collecting and managing field data. Around hundreds plus of the linemen and other supporting staff are required for this manual data collection process (Anderson, 1998). The current metering system in Malaysia is not capable to measure variable time price and it is gradually replaced by digital or smart meters.

Figure 2.1: House energy meter (Wan, 2010)

2.2 Current System

Tenaga Nasional Berhad (TNB) is the largest electricity utility company in Malaysia RM71.4 billion worth in assets and also the largest power company in Southeast Asia (TNB, 2011). It serves over seven million customers throughout Peninsular Malaysia and also the eastern state of Sabah through Sabah Electricity Sdn Bhd (Yahoo Inc., 2011). TNB's core activities are in the generation, transmission and distribution of electricity. Other activities include repairing, testing and maintaining power plants, providing engineering, procurement and construction services for power plants related products, assembling and manufacturing high voltage switchgears, coal mining and trading. Operations are carried out in Malaysia, Mauritius, Pakistan, India and Indonesia (Wikimedia Foundation Inc., 2011).

The current system for this research is TNB online billing system which is known as e-services. Figure 2.2 shows the screenshot of the current TNB system.

Figure 2.2: Main page of TNB

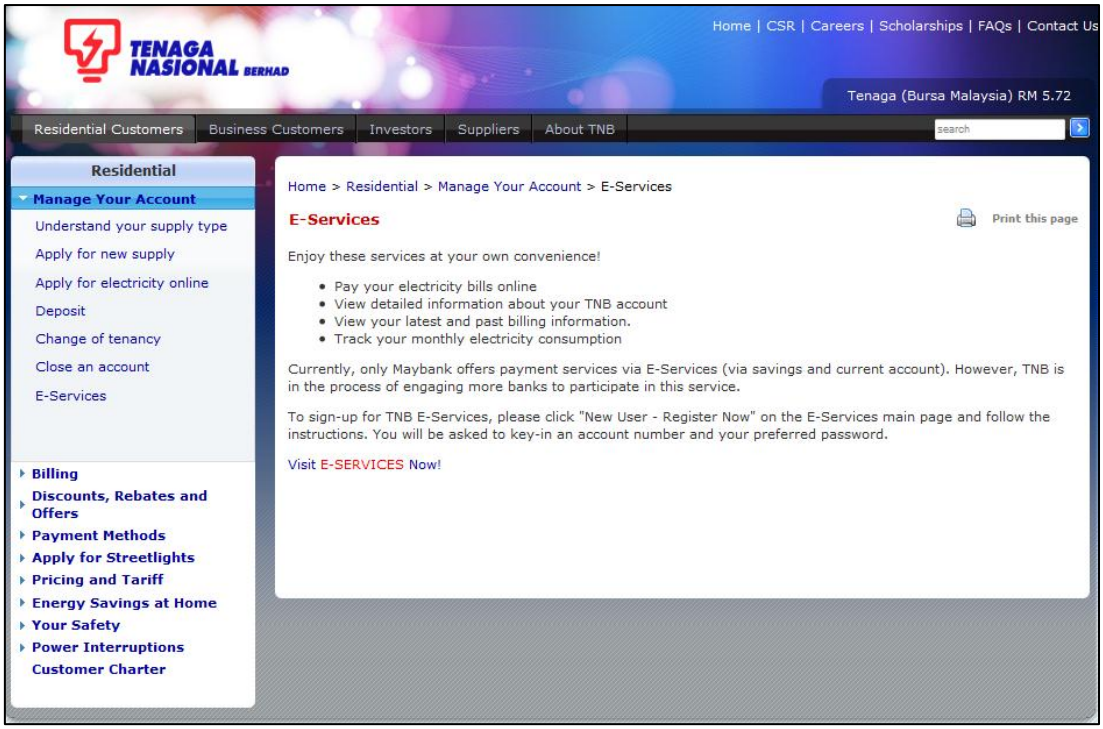

Figure 2.3: E-services page of TNB

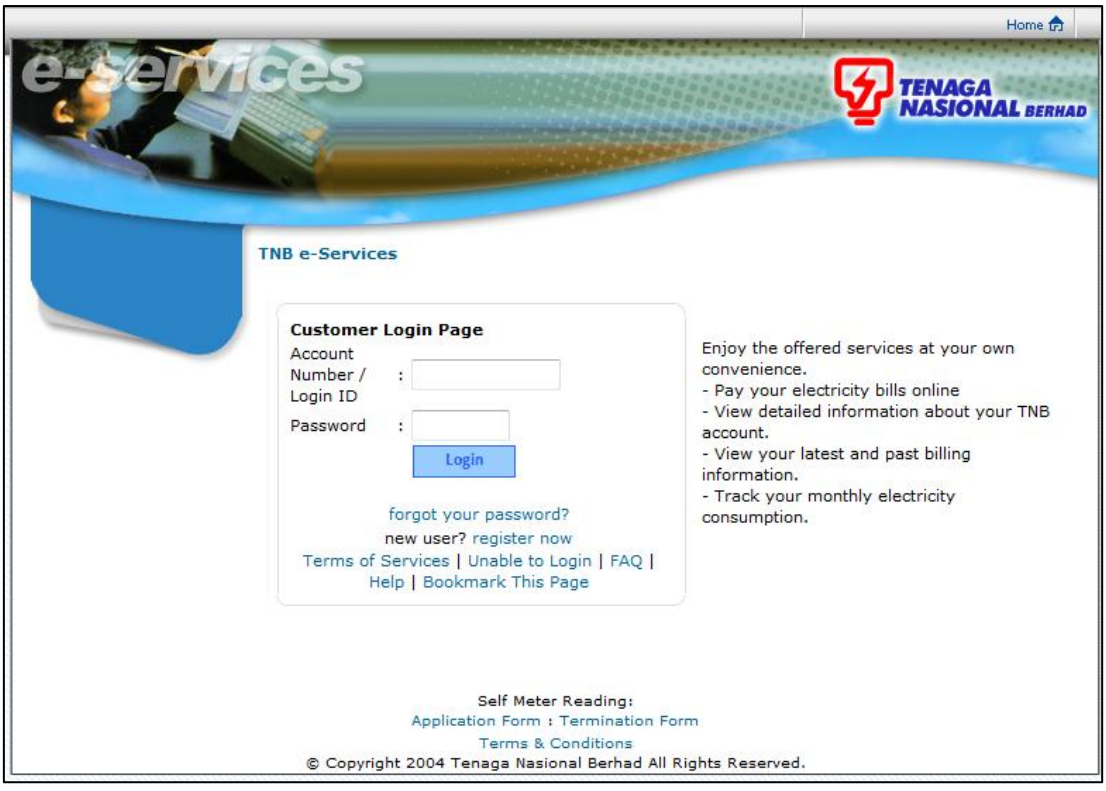

Figure 2.4: Login page of TNB e-services

2.3 Existing Systems

There are several current or existing systems in the market. Three of the systems are ASI EasiBill, Rural Billing, and BillMaster have been chosen for the comparison.

2.3.1 ASI EasiBill System

ASI offers one of the most effective, flexible and complete billing systems available to the utility industry, called EasiBill. This utility billing software provides the tools to improve the billing process while boosting efficiency and productivity to better serve to the customers. Those benefits include the unlimited number of services, multi dial and multiple meters per service locations, penalty or delinquent and cut-off processing, online credit processes and hand-held meter reading interface (Associated Systems Inc., 2010).

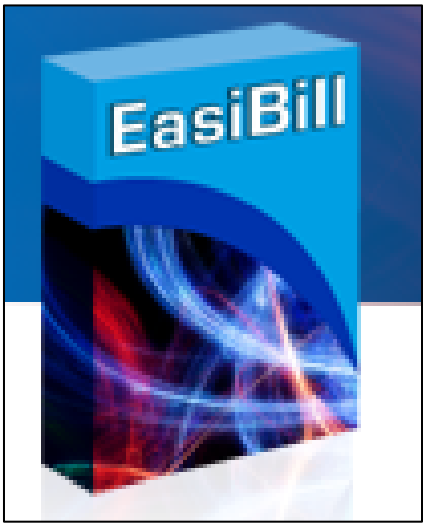

Figure 2.5: ASI EasiBill System

2.3.2 Rural Billing System

Redline Data Systems' Rural Billing utility billing package remains one of the most simple-to-use, expandable and affordable applications available today. Unlike billing systems that are too complex, too limited or too expensive for the smaller utility company such as 3,000 numbers of customers or less. Rural Billing is packed

with all the necessary features for running a small business including unlimited rate schedules, meter reading verification, individual user security settings and much more (Redline Data Systems, Inc, 2011).

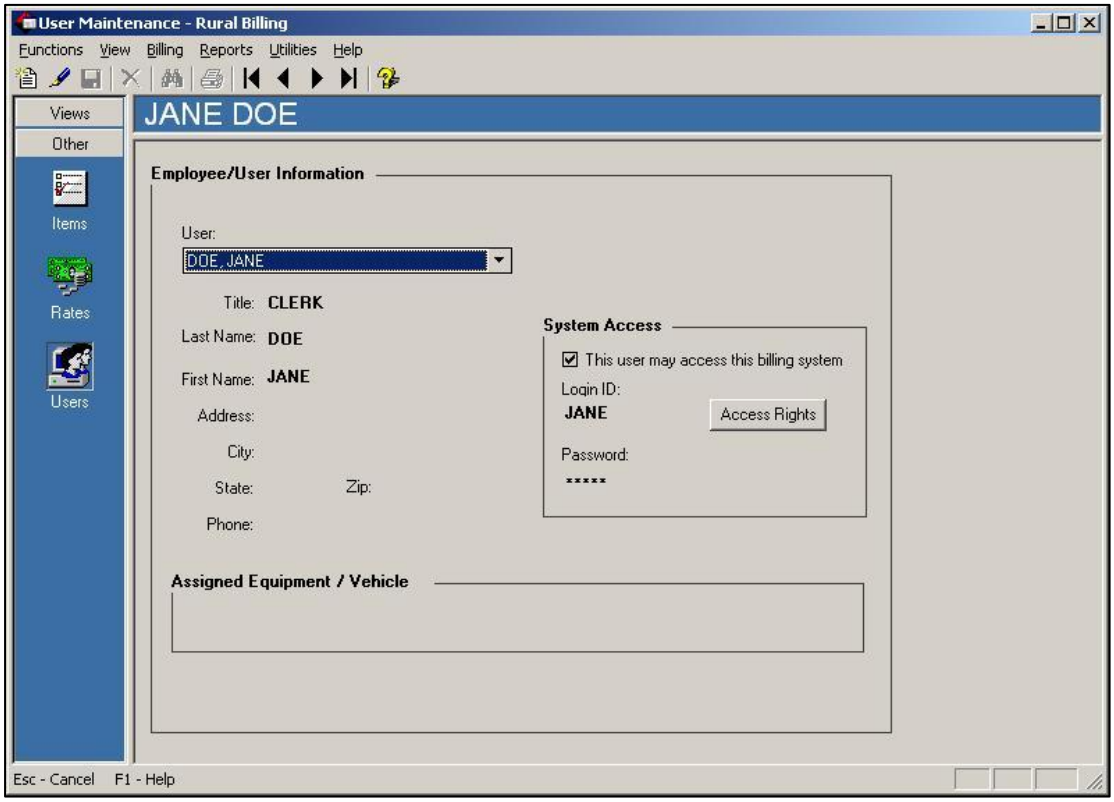

Figure 2.6: Rural Billing System

2.3.3 BillMaster System

BillMaster is a complete Computer Information System (CIS) for billing and management program which includes service orders, meter maintenance history and scheduling in addition to the Customer Relationship Management (CRM) and billing process. BillMaster features customizable account records, flexible reporting options, and unlimited rate schedules and charge calculations. Complex rate structures are supported. Every facet of the billing process may be adjusted to meet the specific needs (Data West Corporation, 2010).